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SE-8299

B. E. - III (Sem. V) (Examination

May / June – 2011

Theory of Machines

Time : Hours] [Total Marks : **100**

Instructions :

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ **B. E. - 3 (SEM. 5)**

Name of the Subject :

☛ **Theory of Machines**

☛ Subject Code No. : **8 2 9 9** ☛ Section No. (1, 2,.....) : **NIL**

Seat No. :

Student's Signature

(1) Attempt all questions.
(2) Make suitable assumptions wherever necessary.
(3)Figure to the right indicate full marks.

Q-1 (a) Answer the Following Questions (Any five) **[10]**

1 A disc is spinning with an angular velocity ω rad/sec about the axis of spin.The couple applied to the disc causing precession will be
[a] 1/2 I.ω^2 [2] I.ω^2 [3] 1/2 I.ω ωp [4] I.ω ωp

2 What do you mean by gyroscopic couple?

3 The brakes commonly used in railway train is
[a] shoe brake [b] band brake [c] band and block [d] internal expanding brake

4 Explain self –energizing and self locking effect in brake.

5 When the pitching of a ship is upward, the effect of gyroscopic couple acting on it will be
[a] to move the ship towards port side [b] to move the ship towards star-board
[c] to rise the bow and lower stern [d] to raise the stern and lower the bow

6 Define the following terms
1. Co-efficient of fluctuation of energy.
2. Co-efficient of fluctuation of speed.

7 Explain the application of gyroscopic principles to ship.

Q-1 b Find the angle of inclination with respect to the vertical of a two wheeler negotiating a turn. Given : combined mass of the vehicle with its rider 250 kg, moment of inertia of the engine flywheel 0.3 kg-m^2, moment of inertia of each road wheel 1 kg-m^2, speed of engine flywheel 5 times that of road wheel and in the same direction, height of center of gravity rider with vehicle 0.6 m, two wheeler speed 90 km/hr, wheel radius 300mm, radius of turn 50m. **[10]**

Q-2 a Define brake. Give classification of brakes. [03]

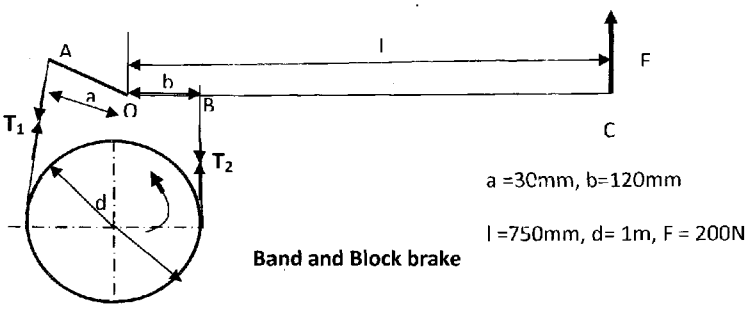
Q-2 b The turbine rotor of a ship has a mass of 2000 kg and rotates at a speed of 3000 r.p.m. clockwise when looking from a stern. The radius of gyration of the rotor is 0.5 m. Determine the gyroscopic couple and its effect upon the ship when the ship is steering to the right in a curve of 100 m radius at a speed of 1855 m/hr.Calculate also the torque and its effect when the ship is pitching in simple harmonic motion, the bow falling with its maximum velocity. The period of pitching is 50 seconds and total angular displacement between the two extreme positions of pitching is 12°. Find the maximum acceleration during pitching motion. [12]

OR

Q-2 b A band and block brake, having 14 blocks each of which subtends an angle of 15° at the centre, is applied to a drum of 1m effective diameter. The drum and flywheel mounted on the same shaft has a mass of 2000 kg and a combined radius of gyration of 500 mm. The two ends of the band are attached to pins on opposite sides of the brake lever at distances of 30mm and 120mm from the fulcrum. If a force of 200N is applied at a distance 750 mm from the fulcrum , find [12]

[1] maximum braking torque [2] angular retardation of the drum [3] time taken by the system to come to rest from the rated speed of 360 r.p.m.

The co-efficient of friction between blocks and drum may be taken as 0.25.



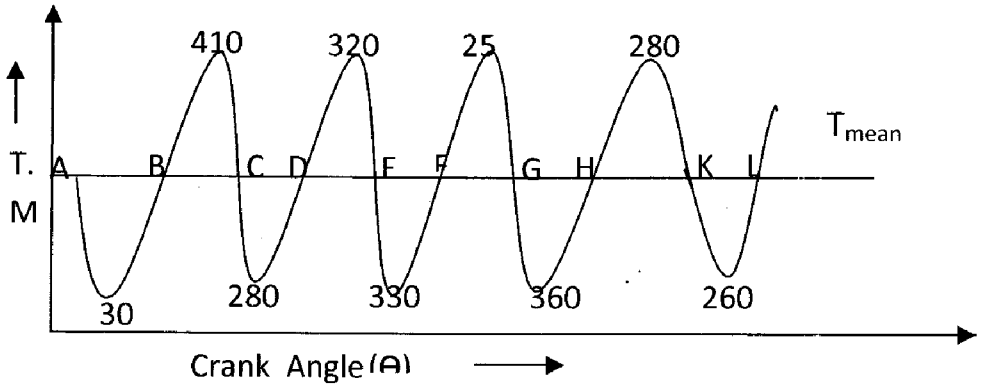
Band and Block brake

Q-3 a Explain T-θ diagram for four strokes I.C. engine [03]

Q-3 b A punching press is driven by a constant torque electric motor.The press is provided with a flywheel that rotates at maximum speed of 225 r.p.m.The radius of gyration of the flywheel is 0.5 m.The press punches720 holes per hour, each punching operation takes 2 second and requires 15 kN-m of energy. Find the power of the motor and minimum mass of the flywheel if speed of the same is not to fall below 200 r.p.m. [12]

OR

Q-3 b Turning moment curve for one revolution of a multicylinder engine above and below line of mean resisting torque are given by -30, +410,-280,+320,-330,+250, -360, +280 and -260 sq.mm.The vertical and horizontal scales are 1mm=500 N-m and 1 mm=6° respectively. The engine has a stroke of 300 mm and the fluctuation of speed is not to exceed ± 2 percent of mean speed which is 800 r.p.m. Determine suitable diameter and cross-section of flywheel rim.Value of safe centrifugal stress of 7 MPa.Density of rim material is 7200 kg /m³. Assume width of rim equal to 5 times its thickness. [12]



Q-4 (a) Answer the Following questions (any five) **10**

1. By means of controlling force curves, explain the stable, unstable and isochronous of spring controlled governor.
2. What is the differences between centrifugal and inertia type governors?
3. Give atleast two examples of gravity controlled and spring controlled governor.
4. Define and explain the following terms relating to governors

   (1) Hunting (2) Stability
5. What is the function of governor? How does it differ from that of a flywheel?
6. Define "D 'Alembert Principle".
7. Define and explain the following terms

   (1) Body Generation (2) Path Generation

(b) A vertical single cylinder single acting diesel engine has a cylinder diameter 300 mm, stroke length 500 mm, and connecting rod length 4.5 times the crank length. The engine runs at 180 r.p.m. The mass of the reciprocating parts is 280 kg. The compression ratio is 14 and the pressure remains constant during the injection of the oil for 1/10th of the stroke. If the compression and expansion follows the law $p.V^{1.35}$ = constant, find(1) crank-pin effort,(2) thrust on the bearings (3) turning moment on the crank shafts, when the crank displacement is 45 degree from the inner dead centre position during expansion stroke. The Suction pressure may be taken as 0.1 N/mm^2. **10**

Q-5 **(a)** Derive expression for effort and power of a porter governor. **8**

(b) In a spring loaded governor of the hartnell type, the mass of each ball is 1 kg, length of vertical arm of the bell crank lever is 100 mm and that of the horizontal arm is 50mm. The distance of fulcrum of each bell crank lever is 80 m from the axis of rotation of the governor. The extreme radii of rotation of the balls are 75 mm and 112.5 mm. The maximum equilibrium speed is 5 percent greater than the minimum equilibrium speed which is 360 rpm. Find, neglecting obliquity of arms, initial compression of the spring and equilibrium speed corresponding to the radius of rotation of 100 mm. **7**

OR

(b) A hartnell governor having a central sleeve spring and two right angled bell crank levers moves between 290 rpm and 310 rpm for a sleeve lift of 15 mm. The sleeve arms and the ball arms are 80 mm and 120 mm respectively. The levers are pivoted at 120 mm from the governor axis and mass of each ball is 2.5 kg. The Ball arms are parallel to the governor axis at the lowest equilibrium speed. Determine: **7**

1. Loads on the spring at the lowest and the highest equilibrium speeds, and
2. Stiffness of the spring.

Q-6 **(a)** Draw and explain Klein's construction for determining the velocity and acceleration of the piston in a slider crank mechanism. **7**

(b) Determine the Chebychev spacing for function $y = X^{1.5}$ for the range $0 \leq X \leq 3$, Where three precession points are required. For these precision points, determine θ_2, θ_3, and ϕ_2, ϕ_3, if $\Delta\theta = 40°$ and $\Delta\phi = 90°$. **8**

OR

(b) The crank – pin circle radius of a horizontal engine is 300 mm. the mass of the reciprocating parts is 250 kg. When the crank has travelled 60 degree from I.D.C., The difference between the driving and the back pressures is 0.35 N/mm^2. The connecting rod length between centers is 1.2 m and the cylinder bore is 0.5 m. if the engine runs at 250 rpm and if the effect of piston rod diameter is neglected, calculate: **8**

1. Pressure on slide bars,
2. Thrust in the connecting rod,
3. Tangential force on the crank – pin
4. Turning moment on the crank shaft.
